II. STRATEGIES AND SCHEDULES FOR TMDL DEVELOPMENT AND IMPLEMENTATION

1. Waters Impaired by Acid and/or Mineralized Drainage from Coal Mined Land

The following strategy is proposed to set and implement TMDLs on these streams:

(a) Complete conventional land reclamation activities if not already in place.

(b) Conduct additional water quality monitoring to improve documentation of water quality problem. If additional monitoring indicates a waterbody is now in compliance with state standards and water quality trends suggest it will remain in compliance with standards, the waterbody will be removed from the 303(d) list.

(c) For streams impaired only by mineralization (high sulfate levels), conduct a biological study of the stream to see if the aquatic fauna has been altered by the higher sulfate levels. If the study shows a normal aquatic fauna, propose modification of state water quality standards for sulfate for that stream consistent with sulfate levels found in that stream. If this site specific standard is approved, the waterbody would be removed from the 303(d) list.

(d) For acidified streams, streams that were only mineralized but did show alteration of the aquatic fauna and for streams which were mineralized, did not show alteration of the aquatic fauna but were not approved for site specific standards: TMDLs will be established using Toxiroute or a similar mass balance water quality model and allowable loads will have to result in instream conditions which meet all applicable water quality standards. For mineralized waters, TMDL limits will be set for sulfate plus chloride and for acidified waters TMDL limits will be set for pH, alkalinity and sulfate plus chloride.

(e) Hydrogeologic study/treatment feasibility study of each site for which TMDLs will require additional treatment, to determine best treatment options.

(f) Construction of treatment system.

(g) If the treatment system involves a discrete water discharge, a responsible party will have to be identified and they will be issued an NPDES permit with water quality based permit limits consistent with the findings of the TMDL analysis will be issued by Missouri DNR.

(h) Routine post-project water quality monitoring will be initiated by Missouri DNR.

Schedule

Waterbody	Complete Conventiona Land Reclamation	Complete Addn. WQ Monitoring	Complete Aquatic Faunal Studies	Promulgate Site Specifi WQ Stds.		Establish TMDL	Complete Hydro. Studies	Complete Const. of Treatment System	Issue NPDES Permit
Big Otter Cr.	1999	2002		2004	2006	2008	2008		
Trib. B. Otter	1999	2002		2004	2006	2008	2008		
Cedar Cr. (upper)									
sulfate	1999		2005	2007	2009	2011	2011		
pH		1999			2000			2003	
Cedar Cr. (lower)		1999			2004	2009	2011	2011	
Manacle Cr.	1999			2004	2009	2011	2011		
M. Fk. Tebo Cr.									
pH	2000	2000			2001				
sulfate	2000	2001	2001	2006	2008	2010	2012	2012	
E. Fk. Tebo Cr.		2000			2001	2006	2008	2008	
Sugar Cr.	1999			2001	2003	2005	2005		
Trib. Barker s Cr.	1999			2000	2001	2003	2005		
Dark Cr.	2004	2004	2005	2006	2009	2011	2011		
Honey Cr.	2004	2004	2005	2006	2009	2011	2011		
Sugar Cr.									
sulfate	2004	2004	2005	2006	2009	2011	2011		
W. Fk.Tebo Cr.		2002	2002	2003	2004	2006	2008	2008	
Mulberry Cr.	2002	2002	2003	2004	2006	2008	2008		
Monegaw Cr.	2004	2004	2005	2006	2008	2010	2010		
2nd Nicholson	2002	2002	2003	2004	2006	2008	2008		

2. Waters Impaired by Elevated Levels of Chlordane in Fish

The following strategy and schedule is proposed to set and implement TMDLs on these waters with chlordane contamination (Blue River, Creve Coeur Lake, Lake St. Louis, Pleasant Hill Lake)

(a) Additional monitoring of fish tissue of at least two bottom feeding species by Missouri DNR or Department of Conservation, 1999-2002.

(b) Risk assessment by Missouri Department of Health, 2002.

(c) The TMDL will be a fish consumption advisory for these waters that is no more stringent than the advisory for Missouri rural agricultural streams, 2002.

(d) If the advisory for these waters is the same as for rural agricultural streams, these waterbodies will be removed from the 303(d) list. If the advisory for these two waters is more stringent than that for rural agricultural streams, a study of treatment options will be

made and that study completed by 2005, and if necessary, implementation by 2008.

3. Waters Impaired by Drainage from Abandoned Heavy Metal Mining Areas

The following strategy is proposed to set and implement TMDLs on these streams.

(a) Additional water quality monitoring to better document the problem or to pinpoint localized areas that may be contributing the largest amount of the pollutant load.

(b) Establish TMDLs for suspended solids in stormwater runoff from mining areas to these waterbodies. At this time, five types of TMDLs to be used singly or in combination are under consideration: (i) An enforceable total suspended solids limit in a stormwater permit; (ii) Proper design, construction and operation of a sediment retention system or other acceptable erosion control system; (iii) Instream criterion for maximum allowable percent embeddedness of coarse substrate by sand-sized or finer particles. The criterion would be evaluated at riffles within a designated range of flow velocities; (iv) Instream criterion on maximum allowable lead concentration in stream sediments within the silt to sand particle size range; and (v) Biocriteria for aquatic macroinvertebrate animals.

(c) Establish TMDLs for dissolved metals using Toxiroute or an alternative mass balance water quality model, where allowable loads will have to meet all appropriate water quality standards.

(d) Conduct any hydrologic studies that may be necessary to help determine best treatment options.

(e) Construct treatment systems and issue discharge permits.

Schedule

Waterbody	Complete Addn. WQ Monitoring	Establish TMDL for TSS		Establish TMDL for Metals		Complete Hydrologic Studies	Complete Constructio of Treatmen Systems	Issue Discharge Permits
Big River	2005	2006			2009	2009		
Flat River Cr.	2005	2006	2006	2006	2009	2009		
Shaw Branch	2005	2006			2009	2009		
Chat Cr.	2003		2005	2003	2008	2008		
Turkey Cr.	2004		2007	2004	2010	2010		
Center Cr.	2004		2007	2004	2010	2010		
Goose Cr.	1998		1999		2000	1998		
Saline Cr.	1998		1999		2000	1998		
Village Cr.	2005	2006			2009	2009		

Waters Impaired by the Operation of Reservoirs

Releases of water from reservoirs can cause one or more of a number of problems. Most

water released is from the deep water, which tends to be both cooler and has less dissolved oxygen than the stream into which it discharges. That means that receiving waters can have abnormally low levels of dissolved oxygen and rapidly fluctuating water temperatures as releases are started or stopped. Both low dissolved oxygen and rapidly changing water temperatures are bad for aquatic life. In addition, discharges from lakes can cause gas bubble disease in fish due to supersaturation of gases and high water velocities below dams can cause direct mechanical injury to fish and other aquatic life and cause a scouring of the streambed which removes the best substrates for aquatic life (gravel and cobble sized rock, woody debris, aquatic plant beds). Since deep waters in reservoirs often have low levels of dissolved oxygen, they also tend to have more manganese and iron in solution and discharge of these waters tends to aggravate iron and manganese problems in downstream waters used for drinking water supply. Additionally, during periods of high water in reservoirs, standing water backs up into stream channels that normally consist of flowing water, a condition that, if frequent enough, can eliminate certain species of aquatic life that are dependant upon current.

The following strategy will be used to set and implement TMDLs on these waters (Salt River, Cannon Re-reg pool, Brush Creek, Lake of the Ozarks, Lake Taneycomo). Streams below other reservoirs not presently on the 303d list

Continue to monitor these problems to better document nature, extent and severity of the problem and to provide feedback on the success of management measures designed to mitigate these problems.

Evaluate options for operation of hydropower facilities, management of lake elevation, and modification of the dam or its hydropower facilities.

Work with individual reservoir operating authorities to implement management practices to mitigate observed problems.

Streams below other reservoirs not presently on the 303(d) list due to lack of any documented problem but identified in the public participation process as a potential problem area will be high priority for monitoring to determine if any instream impairment is occurring due to the presence and/or operation of the reservoir.

5. Waters Impaired by Discharges from Barite Tailings Ponds

The following strategy and schedule will be used to set and implement TMDLs on these streams (Shibboleth Branch, Tributary to Pond Creek).

(a) Conduct study to evaluate design and operation of all active barite tailings ponds. This will either be done by DNR, a DNR contractor or may be required of the permittee as a condition of NPDES permit renewal. To be completed by 2003.

(b) If the study finds that barite tailings ponds are discharging wastewaters in exceedence of present permit limits, the waterbody in question will be deleted from the

303(d) list and the discharge will be handled as a permit compliance problem. If the study shows the tailings ponds are meeting permit limits, these streams would evaluated for conformance with biocriteria and any physical impairment of the stream by 2007 and TMDLs will be set for these waterbodies by 2008. At this time, three types of TMDLs used either singly or in combination are being considered: (i) More stringent total suspended solids limits in

NPDES permits; (ii) Instream criterion for maximum allowable percent embeddedness of coarse substrate by sand-sized or finer particles; and iii) biocriteria. The embeddedness criterion would be evaluated at riffles within a designated range of flow velocities

Issue NPDES permits consistent with established TMDL by 2009.

6. Waters Impaired by Point Source Wastewater Discharges

The following strategy is proposed to set and implement TMDLs on these streams.

(a) For channelized streams and any other streams where beneficial uses may not be attained even after achieving compliance with water quality standards, conduct a use attainability study. If this study shows impaired beneficial uses will not be attained even after achieving compliance with water quality standards, petition EPA for site-specific standards for the waterbody consistent the potential of the waterbody to meet recognized beneficial uses. If this site specific standard is approved and the waterbody meet these new criteria, the waterbody would be removed from the 303(d) list. If the problem in the waterbody which is prohibiting attainment of beneficial uses even after achieving water quality standards is very similar to that of another waterbody which has already been the subject of a use attainability study, petition EPA for site specific standards based on the findings of the earlier study.

(b) For all waterbodies other than those noted above, conduct waste load allocation study and develop Qual2e mathematical model of each stream. The TMDL will be the maximum effluent concentrations predicted by the model that will meet instream water quality standards.

(c) Issue NPDES permit with water quality based limits which contains schedule for compliance with new permit limits.

(d) Construction and operation of additional treatment facilities.

Schedule

Waterbody	Facility	Complete Use Attainability Study	Complete Waste Load Alloc. Study	Establish TMDL	Issue NPDES Permit	Complete Construction of Treatment Facilities
Rock Cr.	Seckman Valley	1995	1997	1999	2002	
West Elm Place		1995	1997	1999	2002	

St. Francis R.	Farmington West			1997	1999	2000	2003	
Main Ditch	Poplar Bluff	1992	2003	2005	2006	2009		
Buffalo Ditch	Kennett	2003	2005	2007	2008	2011		
Mound Br.	Butler	2003	2005	2005	2006	2009		
Whetstone Cr.	Mtn.Grove		1998	2000	2000	2003		
Davis Creek	Odessa SE		1998	2000	2000	2003		
Cave Springs Br.	Simmons Foods, NPS				2002	2004	2005	2008

7. Other Waters Impaired by Low pH

Although Trace Creek is listed as Category VI for treatability, i.e., no practical treatment methods available, since the problem is primarily due to the geology of the area, a sawdust leachate discharge is aggravating the low pH problems in Trace Creek and this source will be addressed.
The following strategy and schedule will be used to set and implement TMDLs on these streams (Trace Creek).

(a) Complete additional water quality monitoring, 2005.

(b) Use Toxiroute or an alternative mass balance water quality model to set water quality based permit limits for discharge from sawdust pile and issue permit with schedule of compliance for meeting water quality based limits, 2006.

(c) Completion of treatment/remediation system to meet water quality based limits, 2008.

8. Waters Impaired by Instream Gravel Dredging

The following strategy and schedule will be used to set and implement TMDLs on these streams (Osage River).

DNR, using Section 401 Water Quality Certification, will require physical and/or biological monitoring of the river in and near dredge sites as a condition of 401 certification in 1999.

9. Waters Impaired by Recreational Vehicle Traffic

The following strategy and schedule will be used to set and implement TMDLs on these streams
(Kelley Branch, Rocky Fork).

(a) Enact ORV rules for Finger Lakes State Park that will restrict ORV traffic in Kelley Branch to a few stream crossings. Develop a plan for elimination of ORV use of Kelley Branch that may include but is not limited to use of signs, placement of physical barriers and/or enforcement of ORV rules by 2002. Finger Lakes State Park personnel will implement plan by 2003.

10. Waters Impaired by Unknown Pollutants and/or Unknown Sources

The following strategy is proposed to set and implement TMDLs on these waters (Wilson Creek, Pearson Creek, Hinkson Creek).

Complete water quality study of south Springfield metro (Wilson and Pearson creeks), James area including chemical analysis and toxicity testing of normal and stormwater flows by 2001, and identify potentially toxic source areas, 2004. Similar study for Hinkson Creek, completed by 2003.

Increase influent, effluent and instream monitoring for Springfield SW WWTP, as a condition of their NPDES permit, to better characterize effluent quality and instream impacts of effluent discharge, 2001.

Establish and issue stormwater permits for cities of Springfield and Columbia that are consistent with narrative state water quality standards requirements that all waters of the state be free from conditions harmful to aquatic life. Permits would be issued to Springfield by 2005 and Columbia by 2006.

11. Streams Impaired by Elevated Levels of Bacteria and/or Nutrients due to Nonpoint Source Runoff

The following strategy and schedule will be used to set and implement TMDLs on these streams (Shoal Creek, Elk River, Buffalo Creek, Indian Creek, including South, Middle and North Indian creeks, Little Sugar Creek, Big Sugar Creek and Patterson Creek).

Increase water quality monitoring on Shoal, Elk, Buffalo, Indian, Big Sugar and Little Sugar creeks, 2000. Initiate water quality monitoring on Patterson Creek, 1999. Initiate continuous flow monitoring on Buffalo, Indian and Big Sugar Creeks, 2000.

Develop a TMDL for nitrogen and phosphorus for all waters in 2004.

Establish voluntary Watershed Management Plans for the watersheds of these streams that will emphasize the development of farm management plans for all farms in the watershed. Farm management plans should address fertilizer and pesticide management, soil conservation as well as proper manure management and managed grazing practices, 2006.

12. Drinking Water Reservoirs Impaired by Elevated Levels of Pesticides

The following strategy will be used to set and implement TMDLs on these reservoirs, as well as to continue monitoring those with significantly high levels but are not yet listed.

(a) Insure at least quarterly pesticide monitoring of raw waters at all reservoirs listed in the schedule below.

(b) Establish TMDLs as a voluntary Watershed Management Plan for each reservoir watershed. This plan will emphasize the need for a total farm management plans for all farms in the watershed. Farm management plans should address fertilizer and manure management, soil conservation, managed grazing practices as well as an integrated pesticide management plan.

Schedule

Waterbody	Begin Quarterly Monitoring of Raw Waters	Establish TMDLs
Wyaconda Res.	1998	2005
La Belle No. 1 and 2 Res.	1998	2003
Monroe City Rte. J Res.	1998	2003
Vandalia Lake	1998	2003

Waterbody	**Begin Quarterly Monitoring of Raw Waters**	**Establish TMDLs**
Cameron Lower Res.(3)	1998	2003
Hamilton Res.	1998	2003
Higginsville S. Res.	1998	2003
Mark Twain Res.	1998	2004
Smithville Res.	1998	2004
Long Branch Res.	1998	2005

The following waters contain significantly high levels, although they are not listed. Additional monitoring is planned.

Schuyler Co. No. 1 Res.	1998
Lake Thunderhead	1998
Marceline Res.	1998
Pape (Concordia) Res.	1998
Breckenridge Res.	1998
Dearborn Res.	1999
Ridgeway Res.	1998
Shelbina Res.	1998
Spring Fork Res. (Sedalia)	1998
Harrisonville Res.	2000
Sugar Creek Res. (Moberly)	2000
Drexel Res.	2000
Butler Res.	2000

Bucklin Res. 2000
Jamesport Res. 2000

13. Drinking Water Source Supplies Impaired by Taste and Odor Problems

The following strategy and schedule will be used to set and implement TMDLs on these reservoirs (McDaniel, Fellows, Spring Fork and Lamar reservoirs).

Initiate or continue existing monitoring of raw waters for total nitrogen, total phosphorus, and chlorophyll. Initiate or continue records of numbers and frequency of taste and odor complaints, 2000.

Conduct a study of the relationship of nutrients, algae and taste and odor in Missouri drinking water reservoirs, to be completed 2003.

Establish TMDLs as Watershed Management Plan for each reservoir watershed that will emphasize the development of farm management plans for all farms in the watershed. Farm management plans should address fertilizer and manure management managed grazing practices, soil conservation and pesticide management, 2004.

14. Elevated Levels of Heavy Metals in Water, Sediments or Biota due to Operation of Metal Smelters

The following strategy and schedule will be used to set and implement TMDLs on these waters (Big Creek).

(a) Re-issuance of ASARCO Glover NPDES permit with increased instream monitoring for dissolved metals and flow, 1998-99.

(b) Fish tissue sampling of Big Creek by Department of Natural Resources or Missouri Department of Conservation, 1999-2002.

(c) Risk Assessment of fish tissue data by Missouri Department of Health, 2003. A review by DNR of all data from all environmental studies in the area, and determine need for additional environmental data collection. This work to be done in 2003.

(d) Any additional studies as needed by 2006.

(e) TMDL for the smelter should include:
(1) Effluent limits for metals in solution
(2) Effluent limits for particulate metals
(3) Maximum allowed concentrations of selected heavy metals in stream sediments.
TMDLs would be established by 2007.

15. Streams Believed to Have Aquatic Habitat Degradation

The following strategy and schedule will be used to set and implement TMDLs for the 41 streams (other than the Missouri and Mississippi Rivers) listed as having aquatic habitat loss, in Category II as aquatic habitat impaired.

(a) Initiate aquatic macroinvertebrate and or fish community monitoring on these streams for the purpose of assessing the biological integrity of these streams and estimating the degree of habitat degradation. Monitoring of these streams will begin in 2001 and all streams will be monitored by 2008.

(b) Based on application of biocriteria for aquatic macroinvertebrates and best professional judgement for fish and aquatic habitat assessment data, determine which streams do have habitat degradation. These streams will be placed on the Category I 303(d) list. Remaining streams will either be retained on the Category II list for additional monitoring if data is inconclusive, or will be dropped from the 303(d) list if data shows the streams are clearly not impaired.

(c) Establish TMDLs as Watershed Management Plan for the entire watershed of each stream moved to the Category I list. This plan would be a voluntary plan for all farms in the watershed. These plans would address farm operations believed to be contributing to 303(d) impairment and might include soil conservation, riparian zone management, fertilizer, pesticide and manure management. TMDLs for eight streams would be completed each year beginning in 2008 and ending in 2012.

16. Loss of Aquatic Habitat and Aquatic Habitat Degradation on the Missouri and Mississippi Rivers

(a) Access and review all pertinent technical literature on fish and invertebrate ecology of the Missouri and Mississippi rivers, and identify additional research needs that are key to understanding habitat needs of aquatic fauna of these two rivers.

(b) Request USEPA to be the lead agency on development of TMDLs for large interstate rivers. Assist EPA in TMDL development.

17. Streams Impaired by Runoff from Limestone Quarries

The following strategy and schedule is proposed for addressing problems relating to erosion of sediments from limestone mining and stockpile areas on these streams, Dog Creek, Long Creek, and Bynum Creek:

Aquatic invertebrate and/or fish community monitoring and aquatic habitat assessment of all these streams by 2004. Any of these stream segments exhibiting no impairment based on this monitoring would be proposed to be deleted from the 303(d) list.

Development of TMDL studies for all of these streams showing impairment and amendment of NPDES permits for the quarries consistent with TMDL recommendations by 2006.

Implementation of all NPDES permit conditions by 2008.

Post implementation aquatic invertebrate and/or fish community monitoring and aquatic habitat assessment in 2012.

Streams Impaired by Chlorine

Strategy and schedule not yet determined.

NOTE: THE PRECEDING IMPLEMENTATION STRATEGY IS THE DEPARTMENT OF NATURAL RESOURCES BEST ESTIMATE OF WHAT WOULD BE REQUIRED TO MAKE A MEANINGFUL ATTEMPT TO SET TMDLS FOR THESE WATERS IN THE APPROXIMATE TIME FRAME REQUESTED BY THE USEPA. WHILE OTHER STATE OR FEDERAL AGENCIES HAVE REGULATIONS OR AUTHORITIES WHICH WILL MAKE THEM PARTICIPANTS IN THE IMPLEMENTATION OF SOME OF THESE TMDLS, THE WORK REQUIRED OF THE DEPARTMENT OF NATURAL RESOURCES IN THIS STRATEGY MAY EXCEED THE FUTURE MANPOWER AND FINANCIAL RESOURCES OF THE DEPARTMENT.